

Claims

1. An apparatus for examining a liquid sample by titration, comprising
 - 1.1 a light source (2);
 - 5 1.2 a light sensor (3);
 - 1.3 a measuring head (1) which is to be immersed into the liquid sample to be examined, with an optical fibre which receives and conveys light from the light source wherein the measuring head (1) comprises a recess (5) with an interruption in the optical fibre into which the liquid to be examined penetrates when a measuring head (1) is immersed;
 - 10 1.4 wherein the measuring head (1) may be separated from the light source (2) and the light sensor (3); and
 - 1.5 a titration system for the defined addition of a titration liquid into the liquid sample.
- 15 2. An apparatus for examining a liquid sample according to claim 1, characterised in that a feeding apparatus (15) for a crystal former, comprising a lithogenic component of a specific type of crystal, is provided in the liquid sample.
- 20 3. An apparatus for examining a liquid sample according to one of claims 1 or 2, characterised in that the liquid sample is urine.
4. An apparatus for examining a liquid sample according to claim 3, characterised in that the crystal former contains oxalate or phosphate.
- 25 5. An apparatus for examining a liquid sample according to at least one of claims 1 to 4, characterised in that the apparatus comprises a measuring system for determining the concentration of at least one type of ion in the liquid sample.
- 30 6. An apparatus for examining a liquid sample according to claim 5, characterised in that the measuring system determines the ion concentration of a lithogenic substance in the measured liquid.

7. An apparatus for examining a liquid sample according to claim 6, characterised in that the ion concentration of Ca^{2+} in the liquid sample is determined.
- 5 8. An apparatus for examining a liquid sample according to at least one of claims 5 to 7, characterised in that at least one ion-selective field-effect transistor is used for determining the ion concentration.
- 10 9. An apparatus for examining a liquid sample according to at least one of claims 1 to 8, characterised in that the apparatus comprises a measuring system for measuring the pH of the liquid sample.
- 15 10. An apparatus for examining a liquid sample according to at least one of claims 1 to 9, characterised in that the apparatus comprises a temperature-measuring system for measuring the temperature of the liquid sample.
- 20 11. An apparatus for examining a liquid sample according to at least one of claims 1 to 10, characterised in that the apparatus comprises a fluidics system for the defined removal of an amount of the liquid to be examined.
12. An apparatus for examining a liquid sample according to claim 11, characterised in that the fluidics system comprises an apparatus for calibrating with at least one calibration liquid.
- 25 13. An apparatus for examining a liquid sample according to claim 10 or 10, characterised in that the fluidics system comprises cleaning means.
14. An apparatus for examining a liquid sample according to any one of claims 1 to 13, characterised in that an exchangeable sample vessel (8) is provided for receiving the liquid samples.

15. An apparatus for examining a liquid sample according to claim 14, characterised in that the apparatus comprises a sample-receiving region (7) in which the sample vessel (8) can be arranged substantially below the measuring head 1.
- 5 16. An apparatus for examining a liquid sample according to claim 15, characterised in that the sample-receiving region (7) is constructed from stainless steel and/or has a titanium oxide coating.
- 10 17. An apparatus for examining a liquid sample according to claim 15 or 14, characterised in that the sample-receiving region (7) comprises a device which disinfects it using UV light.
- 15 18. An apparatus for examining a liquid sample according to at least one of claims 12 to 17, characterised in that a rotatable sample plate (9) with an indirect drive is provided for the sample vessel (8).
19. An apparatus for examining a liquid sample according to at least one of claims 1 to 18, characterised in that the measuring head (1) is a disposable article.
- 20 20. An apparatus for examining a liquid sample according to claim 19, characterised in that a device which marks a measuring head (1) that has been used once and/or detects a measuring head (1) that has already been used is provided.
- 25 21. An apparatus according to any one of claims 1 to 20, characterised in that the measuring head (1) comprises a holding device (49, 50) for holding on a socket of the apparatus, the holding device comprising a holding means (50), in particular an integral connection component with a set breaking point, which is constructed in such a way that the holding device (49, 50) can only be used once.
- 30 22. An apparatus according to any one of claims 1 to 21, characterised in that the measuring head (1) is constructed in such a way that it conveys the light received from the light source (2) to the light sensor (3).

23. An apparatus according to any one of claims 1 to 21, characterised in that the measuring head (1) is constructed in such a way that it conveys the light received by the light source along a light path, adjacent to which the sensor is arranged, but in which the sensor is not directly arranged.

5

24. An apparatus according to claim 14, characterised by a drive device (12) for moving the measuring head (1) relative to the sample vessel (8), at least a part of a determining device (2, 3, 5, 6.1, 6.2, 12, 13) being provided for determining the liquid level of the liquid sample.

10

25. An apparatus according to claim 24, characterised in that the recess (5) represents a part of the determining device (2, 3, 5, 6.1, 6.2, 12, 13).

15

26. An apparatus according to claim 11, characterised in that a fluid duct 51 of the fluidics system is constructed in the measuring head (1).

20

27. An apparatus according to claim 26, characterised in that the fluid duct (51) is closed via a sealing stopper which is penetrated by a line portion (41) of the fluidics system on the measuring head receiving side in the measuring position of the measuring head (1).

28. An apparatus according to any one of claims 1 to 27, characterised in that a fluid duct of the titration system is constructed in the measuring head (1).

25

29. An apparatus according to any one of claims 1 to 28, characterised by a stirring device (9, 10, 57) for stirring the liquid sample, the measuring head (2) comprising at least one flow component, in particular at least one flow blade (57) for cooperating with the liquid sample.

30

30. An apparatus according to claim 5, characterised in that the measuring system comprises a spectrometer for determining the concentration.

31. A method for examining a liquid sample by titration, characterised in that an apparatus according to any one of claim 1 to 30 is used.
32. A method for examining a liquid sample by titration, comprising the following steps:
 - provision (35) of the liquid sample;
 - measurement (36) of the liquid level of the liquid sample by driving a measuring head (1) into the liquid sample from above;
 - determination (40) of the concentration of at least one type of ion of the liquid sample;
 - performance (43) of crystallisation measurement by feeding a crystal former into the liquid sample and measuring crystal formation, preferably by measuring the transparency of the liquid sample after feeding.
33. A method according either to claim 31 or 32, characterised by the insertion (34) of a new disposable measuring head (1) prior to feeding.
34. A method according to any one of claims 31 to 33, characterised by the cleaning (37) and/or calibration (38) of a concentration-determining sensor (24) prior to concentration determination (40).
35. A method according to any one of claims 31 to 34, characterised by the stirring (39) of the liquid sample prior to concentration determination (40).
36. A method according to any one of claims 31 to 35, characterised by the calculation (44) of a sample parameter from the measured values with the concentration and the transparency.
37. A method according to any one of claims 31 to 36, characterised by the determination of the pH of the liquid sample.

38. A method according to any one of claims 31 to 37, characterised by the determination of the temperature of the liquid sample.